Emergent Geometry: Procedural Modeling Through Behavior

Emergent Geometry (EG) is a new prototype for a new paradigm in content creation. Traditional modeling packages use a combination of vertex editing (3ds Max, Maya, etc) and surface painting (Zbrush, Mudbox, etc). Using simple rules defined by the application, users can construct behaviors to make geometry.

The predominant advantages of this approach are:

- Behaviors allow artists to explore the idea of emergence, which is traditionally only available to the most technically minded artists.
- The shapes constructed are pseudo-random, allowing the artist to create one shape with many different permutations of a similar structure.
- The deterministic nature of the behavior allows models to be stored simply as a set of rules, a random seed and an iteration value. Traditional models are stored as a list of vertices and faces, which is a much larger file.
- Creating organic models of a high genus is easily accomplished with EG.
- Models can be easily exported and worked with in a traditional modeling package once a desired result is achieved in EG.

The construction of meshes in EG is based on two orthogonal components, the Simulation and the Surface. Simulation describes the behaviors of agents in the system. These agents move around the scene and drop attractors (or repulsors), following the behavior rules. The Surface portion of the application takes the environment state, the positions of agents and attractors, and uses a mesh generation technique.

Currently there are 4 techniques for Surfaces in our application:

- Voxels: The Agents and Attractors are visualized with voxel data. This is a realtime rendering method available in the application and can be exported.
- Fast Isosurface: EG contains a real-time marching tetrahedron implementation that may be viewed interactively in the display window as well as exported.
- Slow Isosurface: Like Fast Isosurface, but the Slow Isosurface is not intended to be viewed in real time. It is for when the user would like a single, high quality instance of the mesh for export.
- Trails: For trails, the attractors are not visualized. This is a lofted shape over the path of the agents. Suitable for visualizing simulations such as flocking.

The intended user for EG typically falls into one of two categories. There is, of course, the artist that wishes to explore the concept of emergence. EG may also be of interest to designers that wish to prototype interactions in populations. Because of the quick iteration time for defining behaviors, both of these audiences will find EG a very productive and interesting tool for visualization.